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ABSTRACT

We present a dynamic general equilibrium model with agency costs where: i) firms are heterogeneous in the risk of default; ii) they can choose to raise finance through bank loans or corporate bonds; and iii) banks are more efficient than the market in resolving informational problems. The model is used to analyze some major long-run differences in corporate finance between the US and the euro area. We suggest an explanation of those differences based on information availability. Our model replicates the data when the euro area is characterized by limited availability of public information about corporate credit risk relative to the US, and when European firms value more than US firms the flexibility and information acquisition role provided by banks.

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1 Introduction

Is there a special role of banks in lending? How do bank loans relate to non-intermediated corporate finance raised directly from the financial market? A strikingly robust message from contemporaneous theories of financial intermediation is that banks are more efficient than the market in resolving informational problems through screening and monitoring. Several reasons have been put forward: banks have scale economies and comparative advantages in the production of information and in debt-related monitoring (Diamond (1984)); they have access to inside information, whereas debt holders in capital markets have to rely on publicly available information (Fama (1985)); and banks have better incentives to invest in information acquisition because of their relatively large stake in the funding of the borrower (Boot and Thakor (2009)). Empirical studies have confirmed the special role of banks in resolving informational asymmetries. They have also shown that this role has survived the steady reduction of banks' lending exposure to a single borrower over the recent decade, through the development of securitization and a secondary market for loans (Gande and Saunders (2006)).

In this paper, we ask whether a theory that recognizes a special informational role for banks can account for the behaviour of standard macroeconomic variables as well as the structure of corporate finance. In particular, we aim at replicating some differences between the US and the euro area in key facts such as the composition of debt finance, the debt to equity ratio, the cost of bank finance relative to the cost of bond finance, the corporate default rate, and the return to the accumulation of firm capital.

We cast the informational role of banks into a dynamic general equilibrium model, where firms can choose among different debt instruments. The model is characterized by three features. First, firms need to raise external finance in order to finance production but they have private information about a productivity factor (as in Carlstrom and Fuerst (1997, 1998), and Bernanke, Gertler and Gilchrist (1999), among others). Second, firms experience a sequence of three idiosyncratic productivity shocks, the first being realized before firms take financing decisions, and the third determining the default decision. Third, we introduce two types of financial intermediaries – commercial banks, offering bank financing, and capital mutual funds (CMFs), offering bond financing. We assume that banks are institutions which have close relationships with entrepreneurs, acquiring costly additional information about their second productivity shock and adapting the terms of the debt financing arrangements accordingly,

while market bond financing relies on publicly available information about the first productivity shock only. Because banks spend resources to acquire information and arrange financing accordingly, the bond financing choice is less costly but also riskier for a firm than bank finance. Our distinction raises the rather fundamental and well-known question of where to draw the line between a firm and the market, see Williamson (2002), i.e. what is the difference between transactions carried out on the market rather than inside a firm called a bank? We do not offer a fundamental resolution. Indeed, if a reader wishes to rather interpret our banks as rating agencies, to which entrepreneurs pay a fee for a public report before obtaining tailor-made market bond financing based on the reports of the agencies, she could. However, we interpret these institutions as banks, as the line between markets and banks has to be drawn somewhere, and as we find it reasonable to draw the line here.

We show that, in our model, firms experiencing high risk of default choose to abstain from production, while firms with relatively low risk choose to raise external finance through bonds. Only firms with intermediate degrees of risk choose to sign a contract with banks, because they value the option of getting further information before deciding whether or not to produce. This equilibrium feature of our model is in line with theories of corporate finance arguing that, because bank loans are easier to renegotiate than corporate bonds, firms with relatively higher ex-ante credit risk find the option offered by banks to renegotiate more valuable (Berlin and Mester (1992)). It is also in line with existing empirical evidence showing that firms with relatively higher credit quality (as measured by higher ratio of fixed assets to total assets, credit rating, and profitability) choose to finance through public debt, while firms with lower credit quality choose to finance through bank loans (Denis and Mihov (2003)).

Our modelling assumptions also find support in the existing literature. The distinction we introduce between banks and CMFs is consistent with recent theories of financial intermediation. Banks treat differently firms in situations of financial distress because they are long-term players in the debt market, while bondholders are not. By acquiring information about firms, banks minimize the probability of inefficient liquidation, build a reputation for financial flexibility and attract firms that are likely to face temporary situations of distress (Chemmanur and Fulghieri (1994)). Our modelling of banks also reflects the idea that information acquisition during the relationship with a firm leads to greater contractual flexibility relative to the one offered by financial markets (Boot, Greenbaum and Thakor (1993)).

The contribution of our paper is twofold. First, we embed firms' heterogeneity in a dynamic general equilibrium model where financial contracts are optimal, without giving up analytical tractability. Firms' financing decisions are a function only of the distributional assumptions about the idiosyncratic shocks and of an aggregate markup variable, which acts as a summary statistic of the economy. Linearity in the firm's net worth allows to aggregate easily across firms, so the economy can be described by a system of aggregate conditions similar to those arising in models without heterogeneity.

Second, we calibrate the model to replicate some key facts about corporate finance in the US and the euro area. Some ingredients of our model, such as the degree of heterogeneity of firms in the risk of default or the uncertainty that banks are able to disclose about firms' productivity, cannot be confronted directly with the data because of limited empirical evidence. Our calibration procedure offers an indirect estimation of those unobserved characteristics. We can thus offer an explanation of the documented differences based on a structural model.

A broad literature claims that corporate finance differences are largely explained by legal systems and institutional settings (see e.g. La Porta et al. (1997)). It is argued that countries with more effective legal protection of shareholders and creditors (e.g. common law countries such as the UK and the US) are those where entrepreneurs have higher valuation of securities and broader access to capital markets relative to countries with lower legal protection (e.g. civil law countries such as France, Germany and most countries whose legal system is based on Roman law). Thus, theories of legal determinants would predict - everything else equal - a larger role of market finance relative to intermediated finance, and easier access to equity finance, for firms in the US than in the euro area. These theories also predict that better legal protection enables financiers to offer entrepreneurs external finance at better terms in the US rather than Europe.

The empirical evidence - such as the lower share of bank finance in total debt finance and debt to equity ratio in the US relative to the euro area - indeed provides support to the idea that legal and institutional factors are a major determinant of firms' financial structure. However, the data also show that the interest rate spreads on bank loans are higher in the US than in the euro area, while there is no significant differences in spreads on bond finance. This is at odds with the lower-cost implication of higher legal protection in the US, but we show it to be consistent with our model, which emphasizes differences in fundamentals. Our model explains these differences as due to relatively lower availability of public information about firms' credit

worthiness and higher need for the flexibility and information acquisition role offered by banks in the euro area. We therefore view our model as providing an important complement and addition to an explanation which is based entirely on legal determinants. In this paper, we use the model to explain the entire US-euro area differences for several key statistics. While the truth may lie in between, our exercise shows that a legal determinants theory is not needed to explain the differences, and therefore provides an alternative explanation.

The paper proceeds as follows. In section 2, we describe the environment. In section 3, we present the analysis. In section 4, we illustrate the main qualitative properties of the model. In section 5, we use the model to provide an explanation of corporate finance differences between the US and the euro area based on fundamentals. In section 6, we conclude.

2 The Model

We cast the different role of corporate bonds and bank loans into a dynamic general equilibrium model with credit market frictions, where we maintain the assumption of one-period maturity of the debt.

The economy is inhabited by identical infinitely-lived households, a continuum of heterogeneous firms owned by infinitely lived risk-neutral entrepreneurs, and two types of zero-profits financial intermediaries (here onwards FIs). Each firm, indexed by $i \in [0, 1]$, starts the period with some physical capital. It hires additional capital as well as labor, financed externally.

Two key ingredients allow to introduce a non-trivial choice of firms among alternative instruments of external finance. The first is the existence of two distinct types of FIs, where banks are willing to spend resources to acquire information about an unobserved productivity factor, while CMFs are not. The second key ingredient is a sequence of three idiosyncratic productivity shocks hitting each firm. The first shock, $\varepsilon_{1,it}$, is publicly observed and realizes before firms take financial and production decisions. The second shock, $\varepsilon_{2,it}$, is not observed by anyone. Information on the realization of this shock can be acquired by the bank at a cost, in exchange of an up-front fee paid by the firm¹. The third shock, $\varepsilon_{3,it}$, realizes after borrowing occurs and is observable to the entrepreneur only. It can be monitored at a cost

¹An alternative interpretation is to view “banks” in this model as “consultants”, examining the business plans of firms, or to view them as originators of asset-backed securities, by providing screening and monitoring of applicants. Indeed, the banking sector has moved towards that role in recent years: we view this as consistent with our model, if enlarged with a market for asset-backed securities.

by FIs at the end of the period. The first shock generates observable heterogeneity among firms in the risk of default. The second shock, in combination with the information acquisition role of banks, provides the rationale for choosing bank finance for firms facing high risk of default. The combination of these two shocks is crucial to generate cross-sectional variation in firms' financing choices. Finally, the third shock rationalizes the existence of risky debt as the optimal contract between lenders and borrowers.

2.1 Households

Households maximize the expected value of the discounted stream of future utilities,

$$E_0 \sum_{t=0}^{\infty} \beta^t [\ln c_t + \eta (1 - l_t)], \quad 0 < \beta < 1, \quad (1)$$

where β is the households' discount rate, c_t is consumption, l_t denotes working hours and η is a preference parameter. The households are also the owners of the FIs, to which they lend on a trade credit account to be settled at the end of each period. They face the budget constraints

$$c_t + k_{t+1} - (1 - \delta)k_t \leq w_t l_t + r_t k_t, \quad (2)$$

where w_t denotes the real wage and r_t the rental rate on capital.

2.2 Entrepreneurs

Each entrepreneur i enters the period holding capital z_{it} . The firm operates a CRS technology

$$y_{it} = \varepsilon_{1,it} \varepsilon_{2,it} \varepsilon_{3,it} H_{it}^{\alpha} K_{it}^{1-\alpha}, \quad (3)$$

where K_{it} and H_{it} denote the firm-level capital and labor, respectively. The productivity shocks $\varepsilon_{1,it}$, $\varepsilon_{2,it}$ and $\varepsilon_{3,it}$ are random iid disturbances², which occur at different times during the period. They have mean unity, are mutually independent and have aggregate distribution functions denoted by Φ_1 , Φ_2 and Φ_3 respectively. Per independence assumption, these are also the marginal distributions. The entrepreneur faces the constraint that the available funds, x_{it} , need to equal the costs of renting the factors of production,

$$x_{it} = w_t H_{it} + r_t K_{it}. \quad (4)$$

²Alternatively, one can allow for $\varepsilon_{1,it}$ to be persistent over time, $\varepsilon_{1,it} = \rho \varepsilon_{1,i,t-1}$ for some $|\rho| < 1$. This would affect the analysis via the intertemporal condition (25), since the expectation there would now be conditional on $\varepsilon_{1,it}$. One resolution to this issue is to posit an alternative model of the entrepreneur as dying and consuming his entire wealth with some constant probability each period, and otherwise saving everything.

Entrepreneurs are infinitely lived, risk-neutral and more impatient than households. They discount the future at a rate $\beta\gamma$, where β is the discount factor of households and $0 < \gamma < 1$. Their problem is to maximize the expected value of the discounted stream of future utilities,

$$E_0 \sum_{t=0}^{\infty} (\beta\gamma)^t e_{it}, \quad 0 < \gamma < 1, \quad (5)$$

subject to the budget constraint

$$e_{it} + z_{it+1} = y_{it}^e, \quad (6)$$

Here e_{it} denotes entrepreneurial consumption, z_{it+1} investment in physical capital to be used in period $t + 1$, and y_{it}^e entrepreneurs' profits in units of output. Because entrepreneurs are more impatient than households, they demand a higher internal rate of return to investment. This opens the room for trade between households and entrepreneurs despite the agency costs of external finance.

For the purpose of matching the model to data, we interpret the entrepreneurs as the firm owners or stock holders. What is crucial here is that entrepreneurs are more informed about all that is going on inside the firm than the financial intermediaries: an assumption which we do not find entirely unreasonable.

2.3 Agency costs and financial intermediation

Entrepreneurs obtain labor and capital inputs from the households against the promise to deliver the factor payments at the end of the period. Because of default risk, this promise needs to be backed up by a contractual arrangement with a FI (a bank or a CMF). The competitive FIs are able to ensure repayment of the factors because they diversify the risk among the continuum of firms facing idiosyncratic risk. Since credit arrangements are settled at the end of the same period, the intermediaries break exactly even on average.

Let ω_{it} be the uncertain productivity factor at contracting time, when firms approach FIs,

$$\omega_{it} = \begin{cases} \varepsilon_{2,it}\varepsilon_{3,it} & \text{for CMF finance} \\ \varepsilon_{3,it} & \text{for bank finance} \end{cases}$$

Firms that decide to raise finance from banks pay an up-front fee that covers the bank's cost of information acquisition about the signal $\varepsilon_{2,it}$. The fee is a fixed proportion τ of the firm's value n_{it} . This cost is not faced by firms that sign a contract with CMFs, as these FIs do not

acquire information about the unobserved shock. Hence, the disposable net worth of a firm at the time of the contract is given by \tilde{n}_{it} , where

$$\tilde{n}_{it} = \begin{cases} n_{it} & \text{for CMF finance} \\ (1 - \tau)n_{it} & \text{for bank finance} \end{cases}$$

Conditional on $\varepsilon_{1,it}$ and possibly $\varepsilon_{2,it}$, each entrepreneur chooses to invest an amount $0 \leq \hat{n}_{it} \leq \tilde{n}_{it}$ of internal finance and $x_{it} - \hat{n}_{it}$ of external finance, for total funds at hand of x_{it} .

Each FI finances a project whose size is a fixed proportion of the internal funds invested,

$$x_{it} = \xi \hat{n}_{it}, \quad \xi \geq 1. \quad (7)$$

This assumption captures the idea that entrepreneurs differ in their ability: the maximal project size which an entrepreneur is capable of running is proportional to his net worth.

After the realization of the uncertain productivity factor, ω_{it} , the entrepreneur observes the actual production in units of goods, y_{it} , and announces to the FI repayment of the debt or default. The realization of ω_{it} is only known to the firm unless there is costly monitoring, which requires paying a fraction μ of the firm's output. After the announcement of the entrepreneur, the FI decides whether or not to monitor. The informational structure at contracting time corresponds to the costly state verification (CSV) framework of Townsend (1979). Restriction (7) is usually not imposed in the costly state verification literature. It is necessary in our model to ensure that all firms raise finite amounts of external finance despite the presence of ex-ante heterogeneity: otherwise, only the top firms would receive financing, creating a homogenous pool of firms with a potentially high leverage ratio.³

2.4 The timing of events

Entrepreneurs and households enter the period holding respectively capital z_{it} and k_{ht} . Households plan, how much labor to supply, and how much consumption and investment goods to purchase. They also supply labor and rent out their capital stock. Entrepreneurs calculate the end-of-period value n_{it} of their capital holdings z_{it} , which is publicly observable. Financial decisions unfold over three stages.

In the first stage, the shock $\varepsilon_{1,it}$ is realized and publicly observed. Conditional on its realization, entrepreneurs decide whether to:

³This restriction is consistent with the observation of reasonably similar and modest leverage ratios among rather different firms (see Kurshev-Strebulaev (2006), Table 1).

a. Abstain from production. Entrepreneurs facing a low $\varepsilon_{1,it}$ decide not to borrow and not to produce, i.e. they choose $\hat{n}_{it} = 0$. They rent out capital on the market, thus retaining their initial net worth, n_{it} , until the end of the period.

b. Possibly borrow from banks and produce. Entrepreneurs facing an intermediate realization of $\varepsilon_{1,it}$ decide to approach a bank and to postpone their production decision after the realization of $\varepsilon_{2,it}$.⁴

c. Borrow from CMFs and produce. Entrepreneurs facing a high realization of $\varepsilon_{1,it}$ raise external finance from CMFs and decide not to acquire information on $\varepsilon_{2,it}$.

In the second stage, the shock $\varepsilon_{2,it}$ is realized and not observed by anyone. Information on its realization is acquired by banks at a cost τn_{it} and communicated to entrepreneurs. Conditional on $\varepsilon_{2,it}$, entrepreneurs choose their investment level, i.e. whether to:

d. Abstain from production, in which case $\hat{n}_{it} = 0$. These entrepreneurs rent out capital, retaining their remaining net worth, $(1 - \tau)n_{it}$, until the end of the period.

e. Borrow from banks and produce.

Entrepreneurs that have chosen to produce hire labor H_{it} and rent capital K_{it} from the households against the promise to deliver the factor payments at the end of the period. This promise is backed up by the value of their own capital holdings plus the value of the additional trade credit obtained from the FI (either a bank or a CMF).

In the third stage, the shock $\varepsilon_{3,it}$ is realized and observed by the entrepreneur only. The entrepreneurs produces y_{it} , keeps part of output, y_{it}^e , for own consumption and investment, and sells the rest to households to settle trade credit. Entrepreneurs announce the outcome of production and repay loans or default on loans, if they cannot repay the agreed-upon amount. Conditional on the announcement, the FI decides whether or not to monitor.

At the end of the period, entrepreneurs consume e_{it} and accumulate capital $z_{i,t+1}$. Households use the goods purchased for consumption c_t and investment in capital $k_{h,t+1}$.

⁴At this point, we could introduce the possibilities for entrepreneurs to enter actuarially fair gambles or, equivalently, assume that banks are allowed to cross-subsidize projects. As common in the literature, we outlaw gambling and cross-subsidization. An assumption which can rule out the benefits of such gambles is sufficient risk aversion for the entrepreneurs. This, however, would substantially increase the complexity of the model.

3 Analysis

3.1 Factor prices and the markup

Each entrepreneur's net worth is given by the market value of the accumulated capital stock,

$$n_{it} = (1 - \delta + r_t) z_{it}. \quad (8)$$

Firms that produce need to sign a contract with the FIs to raise external finance for total funds at hand x_{it} . Normalizing goods prices, the firm's demand for labor and capital is derived by maximizing expected profits subject to the financing constraint (4). Denote with $\mathcal{E}[\cdot]$ the expectation taken with respect to the variables yet unknown at the time of the factor hiring decision. More precisely,

$$\mathcal{E}[\varepsilon_{1,it}\varepsilon_{2,it}\varepsilon_{3,it}] = \begin{cases} \varepsilon_{1,it} & \text{for CMF financed firms,} \\ \varepsilon_{1,it}\varepsilon_{2,it} & \text{for bank financed firms.} \end{cases}$$

Also, denote the Lagrange multiplier on (4) as $s_{it} - 1$. Optimality implies that

$$\begin{aligned} K_{it} &= (1 - \alpha) \frac{x_{it}}{r_t}, \\ H_{it} &= \alpha \frac{x_{it}}{w_t}, \\ \mathcal{E}[y_{it}] &= s_{it}x_{it}, \end{aligned}$$

where

$$s_{it} = \begin{cases} \varepsilon_{1,it}q_t & \text{for CMF finance,} \\ \varepsilon_{1,it}\varepsilon_{2,it}q_t & \text{for bank finance,} \end{cases} \quad (9)$$

and $q_t = \left(\frac{\alpha}{w_t}\right)^\alpha \left(\frac{1-\alpha}{r_t}\right)^{1-\alpha}$. We can interpret q_t as an aggregate distortion in production arising from the presence of agency costs, and s_{it} as a firm-specific markup which firms need to charge in order to cover the costs of financial intermediation.⁵

3.2 Financial structure

In our model, the financial contract is intra-period but the game between firms and FIs unfolds over three stages, each one corresponding to one idiosyncratic productivity shock. We solve the model using backward induction. In an appendix available from the authors upon request (henceforth appendix NFP), we provide proofs of the propositions stated in this section.

⁵In Carlstrom and Fuerst (1998), as in most of the literature, nothing is known before firms produce, i.e., $\mathcal{E}[\varepsilon_{1,it}\varepsilon_{2,it}\varepsilon_{3,it}] = 1$ and $s_{it} = q_t$.

In stage III, firms and FIs stipulate a debt contract conditional on the available information. Let Φ_ω and φ_ω be respectively the distribution and density function of ω_{it} and define

$$f(\bar{\omega}^j) = \int_{\bar{\omega}^j}^{\infty} (\omega - \bar{\omega}^j) \Phi_\omega(d\omega), \quad (10)$$

$$g(\bar{\omega}^j) = \int_0^{\bar{\omega}^j} (1 - \mu) \omega \Phi_\omega(d\omega) + \bar{\omega}^j [1 - \Phi_\omega(\bar{\omega}^j)], \quad (11)$$

as the expected shares of final output accruing respectively to an entrepreneur and to a lender, after stipulating a contract that sets the fixed repayment at $s_{it}\bar{\omega}_{it}^j x_{it}$ units of output, for $j = b, c$. The index j denotes the type of FI, where b indicates banks and c indicates CMFs. The optimal contract solves the following CSV problem:

$$\max s_{it} f(\bar{\omega}_{it}^j) x_{it} \quad (12)$$

subject to constraint (7) and

$$s_{it} g(\bar{\omega}_{it}^j) x_{it} \geq x_{it} - \hat{n}_{it} \quad (13)$$

$$f(\bar{\omega}_{it}^j) + g(\bar{\omega}_{it}^j) \leq 1 - G_\omega(\bar{\omega}_{it}^j) \quad (14)$$

$$\hat{n}_{it} \geq 0, \quad s_{it} f(\bar{\omega}_{it}^j) x_{it} \geq \hat{n}_{it}. \quad (15)$$

where $G_\omega(\bar{\omega}^j) = \mu \int_0^{\bar{\omega}^j} \omega^j \Phi_\omega(d\omega)$. Equation (7) restricts the project size,⁶ (13) requires the FI's expected return to exceed the repayment to the household, (14) ensures feasibility, and (15) guarantees that the entrepreneur is willing to sign the contract. Since loans are intra-period, the opportunity cost of lending for the intermediary is one.

Proposition 1 *Under the optimal contract, the entrepreneur either invests nothing, $\hat{n}_{it} = 0$, or invest his entire net worth, $\hat{n}_{it} = \tilde{n}_{it}$, requiring an amount $(\xi - 1)\tilde{n}_{it}$ of external finance. The optimal contract is characterized by a threshold $\bar{\omega}_{it}^j$, $j = b, c$, such that, if $\omega \geq \bar{\omega}_{it}^j$, no monitoring occurs. If $\omega < \bar{\omega}_{it}^j$, the FI monitors at a cost and completely seizes the resources in the hands of the entrepreneur. The threshold is given by the solution to*

$$s_{it} g(\bar{\omega}_{it}^j) = \frac{\xi - 1}{\xi}. \quad (16)$$

⁶It is standard in this literature to have the project size (and leverage) optimally chosen by the contract. In our environment, instead, firm-level leverage is fixed by equation (7). The reason is that firms differ in terms of credit-worthiness. If the distribution of ε_{1t} is unbounded, the optimal project size for firms experiencing extremely large values of that shock is unbounded. If the distribution is bounded, one typically obtains a corner solution, with all financing going to the best firms.

At the beginning of stage II, $\varepsilon_{2,it}$ is realized and not observed. Information on this shock is acquired by banks and communicated to the entrepreneur, who then chooses whether to abstain from production or to obtain trade credit and produce.

Proposition 2 *A threshold for $s_{it} = \varepsilon_{1,it}\varepsilon_{2,it}q_t$, below which the entrepreneur does not proceed with the bank loan, exists and is unique. It is given by a constant s_d that satisfies*

$$s_d f(\bar{\omega}^b(s_d))\xi = 1. \quad (17)$$

Condition (17) also determines a threshold for the second firm-specific shock. The entrepreneur does not proceed with the bank loan if $\varepsilon_{2,it} < s_d/(q_t\varepsilon_{1,it})$.

In stage I, after $\varepsilon_{1,it}$ realizes, the entrepreneur chooses whether or not to produce and, if he does, how to finance production. For notational simplicity, we drop the subscripts. The expected profits of an entrepreneur, who proceeds with bank finance conditional on the realization of ε_1 , is $F^b(s)n$, where $s = \varepsilon_1q$ and

$$F^b(s) = (1 - \tau) \left(\int_{\frac{s_d}{s}} s\varepsilon_2 f(\bar{\omega}^b(s\varepsilon_2))\xi\Phi_2(d\varepsilon_2) + \Phi_2\left(\frac{s_d}{s}\right) \right). \quad (18)$$

The expected profits of an entrepreneur, who proceeds with CMF finance conditional on the realization of ε_1 , is $F^c(s)n$, where $s = \varepsilon_1q$ and

$$F^c(s) = s f(\bar{\omega}^c(s))\xi. \quad (19)$$

Finally, the expected profits of an entrepreneur, who abstains from production, is simply n . Note that all payoff functions are linear in net worth n . Knowing its own mark-up $s = \varepsilon_1q$, each entrepreneur chooses the best option, leading to the overall payoff $F(s)n$, where

$$F(s) = \max\{1; F^b(s); F^c(s)\}. \quad (20)$$

In the analysis below, we make the following assumptions: (A1) $F^b(s) \geq 0$; and (A2) $F^b(s) < F^c(s)$, for all $s = \varepsilon_1q$. These conditions impose mild restrictions on the parameters of the model and ensure uniqueness of the thresholds s_b and s_c .

Proposition 3 *Under (A1), a threshold for $s = \varepsilon_1q$, below which the entrepreneur decides not to raise external finance, exists and is unique. It is given by a constant s_b that satisfies*

$$F^b(s_b) = 1. \quad (21)$$

Under (A1) and (A2), a threshold for $s = \varepsilon_1 q$ above which entrepreneurs sign a contract with the CMF, exists and is unique. It is given by a constant s_c that satisfies

$$F^b(s_c) = F^c(s_c). \quad (22)$$

Conditional on s_b , s_c and q_t , and depending on $\varepsilon_{1,it}$, entrepreneurs split into three sets: Ω_{at} , the set of entrepreneurs that abstain from raising external finance; Ω_{bt} , the set of entrepreneurs that sign a contract with banks, and Ω_{ct} , the set of CMF-financed entrepreneurs,

$$\begin{aligned} \Omega_{at} &= \{\varepsilon_{1,it} \mid \varepsilon_{1,it} < s_b/q_t\} \\ \Omega_{bt} &= \{\varepsilon_{1,it} \mid s_b/q_t \leq \varepsilon_{1,it} \leq s_c/q_t\} \\ \Omega_{ct} &= \{\varepsilon_{1,it} \mid \varepsilon_{1,it} > s_c/q_t\}. \end{aligned}$$

The firm's production decision can be characterized by the dummy variable D_{it} , where

$$D_{it} = \begin{cases} 1 & \text{if } \varepsilon_{1,it} > s_c/q_t \text{ or if } s_b/q_t \leq \varepsilon_{1,it} \leq s_c/q_t \text{ and } \varepsilon_{2,it} > s_d/\varepsilon_{1,it}q_t, \\ 0 & \text{else.} \end{cases}.$$

3.3 Consumption and investment decisions

Households maximize (1) subject to (2). Optimality requires that

$$\eta c_t = w_t \quad (23)$$

$$\frac{1}{c_t} = \beta E_t \left\{ \frac{1}{c_{t+1}} (1 - \delta + r_{t+1}) \right\}. \quad (24)$$

Entrepreneurs maximize (5) subject to (6), where $y_{it}^e = \tilde{n}_{it}$ if firm i abstains, $y_{it}^e = s_{it} (\omega_{it} - \bar{\omega}_{it}^j) \xi \tilde{n}_{it}$ if firm i borrows and repays, and $y_{it}^e = 0$ if firm i borrows and default. Their optimality condition is given by

$$1 = \beta \gamma E_t \{(1 - \delta + r_{t+1}) F(\varepsilon_{1,it+1} q_{t+1})\}. \quad (25)$$

3.4 Aggregation

Aggregate variables can be computed by integrating across firms. Aggregate labor and capital are given by

$$w_t H_t = \alpha x_t, \quad (26)$$

$$r_t K_t = (1 - \alpha) x_t. \quad (27)$$

Aggregate demand for funds, x_t , output y_t , output lost to monitoring costs y_t^m , output lost to banks' information acquisition y_t^τ , and agency costs can be computed as

$$x_t = \psi_x(q_t) \xi n_t \quad (28)$$

$$y_t = \psi_y(q_t) q_t \xi n_t \quad (29)$$

$$y_t^m = \psi_m(q_t) \mu \xi q_t n_t \quad (30)$$

$$y_t^\tau = \psi_\tau(q_t) n_t \quad (31)$$

$$y_t^a = y_t^m + y_t^\tau. \quad (32)$$

Aggregate entrepreneurial consumption and investment have to satisfy the constraint

$$e_t + z_{t+1} = \vartheta(q_t) n_t, \quad (33)$$

where $\vartheta(q_t) n_t$ denote aggregate profits of the entrepreneurial sector.

Notice that $\psi_x(\cdot)$, $\psi_y(\cdot)$, $\psi_m(\cdot)$, $\psi_\tau(\cdot)$ and $\vartheta(\cdot)$ are functions that aggregate across firms. For instance, $\psi_\tau(q)$ aggregates the costs of information acquisition per unit of net worth across all firms that sign a contract with a bank, implying that

$$\psi_\tau(q) \equiv \tau \int_{\frac{s_b}{q_t}}^{\frac{s_c}{q_t}} \Phi_1(d\varepsilon_1).$$

The other functions are defined in appendix NFP, where we also derive condition (32).

3.5 Market clearing

Market clearing for capital, labor and output requires that

$$K_t = k_t + z_t, \quad (34)$$

$$H_t = l_t, \quad (35)$$

$$y_t = c_t + e_t + y_t^a + K_{t+1} - (1 - \delta)K_t. \quad (36)$$

Market clearing for loans is ensured by condition (4).

4 Equilibrium properties of the model

We parameterize the model at the stochastic steady state.⁷ To discuss equilibrium properties, we use the parameterization of the model calibrated on US data reported in section 5.2.

⁷The stochastic steady state and the numerical procedure for computing it are described in appendix NFP.

In Figure 1, we show expected profits for entrepreneurs. Panel (a) plots expected profits from abstaining, from signing a contract with a bank and from signing a contract with a CMF, as a function of the firm's mark-up, s . The intersection points of the three curves provide the cutoff points, s_b and s_c . When $s < s_b$, the firm abstains because this provides highest expected profits. When $s_b < s < s_c$, the best option is offered by bank finance, while when $s > s_c$ the firm chooses CMF finance. The panel also shows the mean of the firm-specific mark-up s , plus/minus two standard deviations. After the realization of ε_1 , 95% of the firms' markups lie within this region. Panel (b) shows how expected profits from bank finance move with the information acquisition fee τ . When $\tau = .001$, information acquisition is so cheap that expected profits from bank finance generally exceed those from abstaining or from CMF finance. The share of firms that raises external finance through banks approaches one. When τ is large (.04 in the figure), the option value of acquiring more information is not large enough to offset the cost. All firms either abstain or use CMF finance. Only for intermediate values of τ (.02 in the figure), firms that decide to produce differentiate in terms of their financing choice depending on the realization of their markup.

Figure 2, panel (a), illustrates how firms allocate among financial instruments. Firms experiencing a productivity shock $\varepsilon_1 \leq s_b/q$ decide to abstain from production. Firms with $s_b/q \leq \varepsilon_1 \leq s_c/q$ sign a contract with banks. Firms with $\varepsilon_1 \geq s_c/q$ sign a contract with CMFs. Among firms that sign a contract with banks, those experiencing a productivity shock below the threshold for ε_2 , i.e. $\varepsilon_2 \leq s_d/\varepsilon_1 q$, decide not to proceed to the production stage. Panel (b) plots the threshold $s_d/\varepsilon_1 q$, over the range of mark-ups ($s_b/q, s_c/q$), as a function of ε_1 .

Figure 3 plots the steady state distribution of firms among production activities. Firms that do not produce are those that decide not to raise external finance because $\varepsilon_1 \leq s_b/q$, and those that sign a contract with the bank but, after the realization of ε_2 , decide to drop out of production. For these firms, $s_b/q \leq \varepsilon_1 \leq s_c/q$ and $\varepsilon_2 \leq s_d/q\varepsilon_1$.

In our model, key parameters for the determination of the financial structure are the standard deviations of the different idiosyncratic productivity shocks, and banks' information acquisition costs. For instance, a higher σ_{ε_1} generates thicker tails in the distribution. Firms experience with lower probability intermediate realizations of the productivity shock ε_1 before taking their financing decisions. Therefore a lower share of firms raises bank finance. Similarly, a higher variance of the signal σ_{ε_2} implies that firms value more the possibility of acquiring additional information through banks. A larger share of firms raises bank finance. Notice

that in our model, a reduction in τ acts as an increase in σ_{ε_2} . Both a reduction in the cost of information acquisition and an increase in the dispersion of the private information signal lead to a larger share of bank finance.

5 Corporate finance in the US and the euro area

5.1 Evidence on the financial structure

In our numerical analysis, we aim at replicating six stylized facts: i) the ratio of bank loans to debt securities, as an indicator of the composition of firms' debt finance; ii) the debt to equity ratio, as a proxy of the reliance on debt versus equity finance; iii) the risk premium on loans and iv) the risk premium on bonds, both reflecting the severity of the asymmetric information problem in financial markets; v) the default rate on bonds, which determines the loss of resources due to bankruptcy for CMF financed firms; and vi) the expected return on capital, which restricts in our model entrepreneurs' profits and their choice between consumption and capital accumulation.

In table 1, columns 2 and 4 summarize the evidence on the financial structure of the EA and the US, for the period 1999-2007.⁸ The table shows several differences. First, bank loans account for a much larger fraction of debt finance in the EA than in the US. The ratio of bank loans to debt securities is approximately eight times larger in the EA (5.48) than in the US (.66). Second, the debt to equity ratio is higher in the EA (.64) than in the US (.43), reflecting a larger reliance of US firms on financing through equity rather than debt. Third, corresponding measures of the risk premium on bank loans are higher for the US (170 bps) than for the EA (119 bps). Fourth, no significant differences can be observed in the risk premium on bond finance (143 bps in both the US and the EA). Finally, both the default rate on corporate bonds and the return to capital are higher for the US (5.37% and 10.9% respectively) than for the EA (4.96% and 9.30% respectively).

The first two facts documented in table 1 are consistent with theories that explain the composition of external finance with institutional and legal factors. For instance, La Porta et al. (1997) analyze the choice between debt and equity finance, and argue that countries with legal environments that offer more effective protection of shareholders and creditors are those

⁸In appendix NFP, we describe the data used to provide evidence on the financial structure of the corporate sector. We also provide analytical expressions for the financial variables used in the numerical application.

where entrepreneurs have higher valuation of securities and broader access to capital markets, and where financiers offer entrepreneurs external finance (both through debt and equity) at better terms. They also show that common law countries (such as the UK and the US) protect both shareholders and creditors more than civil law countries (such as France, Germany and other European countries whose legal system is based on Roman law).

Thus, theories of legal determinants would predict a larger role of market finance in the US than in the EA, in line with the reported evidence on the ratio of bank loans to debt securities. They would also predict easier access to equity finance for firms in common law countries than in civil law countries, in line with a lower debt to equity ratio in the US relative to the EA. On the contrary, our findings on the cost of bank finance relative to bond finance in the two blocks pose a challenge to those theories. Indeed, the average risk premium on bank loans is higher in the US than in the EA, and no significant differences arise in the average risk premium on bonds. These findings are in line with existing studies. On the one hand, Carey and Nini (2007) documents that interest rate spreads on syndicated loans to corporate borrowers are significantly smaller in Europe than in the United States (by about 30 bps), other things equal. Moreover, they argue that differences in borrower, loan, and lender characteristics do not appear to explain this phenomenon. On the other hand, Mahajan and Fraser (1986), and Carey and Nini (2007) provide evidence that no significant differences exist in yields between bonds issued by firms with similar characteristics in the US and in Europe. We interpret this evidence as suggesting that theories of institutional and legal determinants are not sufficient to explain the composition of corporate debt finance.

In the rest of this section, we use our model to shed light on whether differences in fundamentals can offer a complementary explanation.

5.2 Numerical analysis

We search for parameterizations of the model that deliver the best fit with US and EA data. The period is a year. The iid productivity shocks $v = \varepsilon_1, \varepsilon_2, \varepsilon_3$ are lognormally distributed, i.e. $\log(v)$ is normally distributed with variance σ_v^2 and mean $-\sigma_v^2/2$. Both for the US and the EA models, we fix some parameters to standard values. We set the depreciation rate at $\delta = .07$ and the discount factor at $\beta = .96$, implying a real interest rate of around 4%. We choose $\alpha = .64$ in the production function, and a coefficient in preferences η so that labor equal .3 in

steady state. We also set monitoring costs at $\mu = .15$, a value in the middle of the range of the available estimates (see e.g. Carlstrom and Fuerst (1998)).

For the calibration exercise, it is convenient to specify one of the endogenous variables, q , as exogenous and to treat γ as unobservable. Thus, we choose six free parameters, $\xi, \tau, q, \sigma_{\varepsilon_1}, \sigma_{\varepsilon_2}$ and σ_{ε_3} , to minimize the squared log-deviation of the model-based predictions on the six financial facts documented in table 1 from their empirical counterparts.⁹ The parameter values selected from our benchmark calibration procedure are reported in table 2, columns 3 and 4. The table also reports some focal statistics (shown in the last four rows), which we use below to interpret the different predictions generated by the US and EA models. The implied model-based predictions are listed in table 1, columns 3 and 5.

The focal statistics reported in table 2 shed light on the differences in the financial structure, as interpreted by our model. The overall uncertainty about the a priori unobserved productivity shocks, $\sum_{j=2}^3 \sigma_{\varepsilon_j}^2$, is higher in the US (.238) than in the EA (.117).¹⁰ The share of available information due to the additional information acquisition in a bank contract, $\sigma_{\varepsilon_2}^2 / (\sigma_{\varepsilon_1}^2 + \sigma_{\varepsilon_2}^2)$, is considerably higher in the EA (0.958) than in the US (0.294), giving banks and their information acquisition a larger role in the EA. The demand of banking services in the EA is dampened, however, by a relatively low efficiency of european banks. Indeed, the overall measure of efficiency of banks in acquiring information about firms, $\sigma_{\varepsilon_2}^2 / \tau$, is higher for the US (.590) than for the EA (.168). Finally, the volatility of the public signal relative to the overall uncertainty, $\sigma_{\varepsilon_1}^2 / \sum_{j=1}^3 \sigma_{\varepsilon_j}^2$, is lower in the EA (.002) than in the US (.006). The larger availability of public information in the US allows firms to better assess their own default risk and to reduce the output loss induced by agency costs.¹¹

⁹As a robustness check, we have also run our calibration exercise by using as a target the average default rate or the default rate on loans instead of the default rate on bonds. In both cases, the match of the model with the data deteriorates but the results on model predictions and the interpretation of the corporate finance differences suggested by our statistics remain qualitatively unchanged.

¹⁰Recent empirical evidence supports this finding. Using a large panel of firms over the period 1991-2006, Bartram et al (2009) show that foreign firms face lower idiosyncratic risk than comparable US firms, after controlling for industry, assets, age, and market-to-book ratio.

¹¹This finding is also in line with available empirical evidence. Indeed, market-based countries such as the US have been shown to have higher standards than bank-based countries for information disclosure about firms, such as accounting information, income statements, balance sheets, funds flow statements, and stock data (see e.g. Demirgüç-Kunt and Levine (2001)).

In table 3, we compare some predictions of the model on variables that were not used as targets of our calibration procedure to their empirical counterparts. The model generates a reasonable ratio of aggregate consumption to GDP, $\frac{c+e}{y}$, and of investment to GDP, $\frac{I}{y}$. Both for the US and the EA, the prediction on the average default rate is not far from the observed value. The model also predicts that default rates on loans are lower than default rates on bonds for the EA, in line with the empirical evidence.

The model has two main shortcomings. First, the predicted ratio of the default rate on loans to the default rate on bonds is higher than one for the US, while it is lower than one in the data. Second, the model delivers a ratio of entrepreneurial wealth to total wealth, $\frac{z}{K}$, which is remarkably lower (.25) than in US data (.46).

Predictions of the model on some unobservable characteristics are documented in table 4. One distinguishing feature is that both in the US and EA models, almost all firms approach a financial intermediary ("share abstain" is very low or zero), since the share of publicly available information $\sigma_{\varepsilon_1}^2 / \sum_{j=1}^3 \sigma_{\varepsilon_j}^2$ is low, see table 2. The share of firms that drop-out from production conditional on having approached a bank ("drop-out if banking") is larger for the EA than for the US, reflecting a higher standard deviation of the relevant uncertain productivity factor (σ_{ε_2}) and therefore a higher occurrence of low realizations of ε_2 . The value of the aggregate markup, q , is larger in the US. This is needed to replicate the observed difference in the expected return to capital in the US and in the EA. A higher financial markup increases the expected profits of entrepreneurs per unit of accumulated capital stock, because it increases the price charged by firms. Finally, agency costs as a share of GDP (y^a/y) are higher in the EA relative to the US, due to the large use of bank finance and the consequent impact of information acquisition costs.

Table 2 shows that the model requires large differences in information acquisition costs, in order to replicate the data. One striking difference arises in the parameter τ , which is .001 for the US and .028 for the EA. This should be understood as the difference between bank and bond financing costs: even the EA parameter is small, so that in absolute terms, the US and EA are fairly similar. However, it is possible that such difference is needed for the model to capture the data, because monitoring costs are assumed to be identical despite differences in bankruptcy laws and procedures. To verify this conjecture, we checked the robustness of our results by restricting τ in the EA model to take progressively closer values to the one obtained for the US, and instead endogenizing the monitoring costs μ . Indeed, the best fit is found for

a lower level of monitoring costs in the EA, $\mu = .124$, and for an information acquisition cost parameter, $\tau = .005$, that is much closer to the one selected for the US. While it is difficult to obtain evidence on monitoring costs in the EA, due to the high heterogeneity in legal systems and bankruptcy law across european countries, these results are consistent with the perception that bankruptcy procedures offer higher protection for business debtors in the US (chapter 11 of the Bankruptcy Code) than in the EA, implying that US banks overall recover a lower fraction of output. A more detailed discussion of the robustness analysis and of the results is available in appendix NFP. What matters here is that the model predictions and the focal statistics turn out to be qualitatively similar for a decently fitting alternative specification, and therefore our interpretation of the corporate finance differences remains unaffected.

6 Conclusions

This paper presents a model where firms are heterogeneous in the risk of default and banks have a special role in resolving informational problems. The model can be used to shed light on the determinants of key differences in corporate finance between the US and the euro area.

Some of the differences that we document are consistent with theories that point to legal and institutional factors as major determinant of firms' financing choices. Some others - such as a higher average risk premium on bank loans in the US relative to the euro area, and the absence of significant differences in the average risk premium on bonds - provide a challenge for these theories. Our model provides a complementary explanation that is based on fundamentals.

We argue that information availability might help to explain the composition of firms' debt. Our calibrated model suggests that differences in the financial structure of US and euro area firms can be explained by: i) a relatively low level of disclosure of information about firms' credit risk in the euro area relative to the US; ii) a higher need of european firms for the flexibility and information acquisition role provided by banks.

Table 1: Financial facts

Variable	US		EA	
	data	mod	data	mod
Bank to bond finance ratio	0.66	0.67	5.48	5.48
Debt to equity ratio	0.43	0.43	0.64	0.64
Risk premium on loans (bps)	170	169	119	119
Risk premium on bonds (bps)	143	143	143	147
Default rate on bonds (pp)	5.37	5.36	4.96	4.79
Return to entr capital (pp)	10.90	10.93	9.30	9.29

Table 2: Parameter values

Parameters	Symbols	Model	
		US	EA
Information acquisition	τ	0.001	0.028
Coeff. discount rate entr.	γ	0.939	0.953
Project size to net worth	ξ	1.551	2.102
Standard dev. ε_1	σ_{ε_1}	0.037	0.014
Standard dev. ε_2	σ_{ε_2}	0.024	0.069
Standard dev. ε_3	σ_{ε_3}	0.488	0.335
Overall variance unobserved shocks	$\sum_{j=2}^3 \sigma_{\varepsilon_j}^2$	0.238	0.117
Precision avail info to precision private info	$\sigma_{\varepsilon_2}^2 / (\sigma_{\varepsilon_1}^2 + \sigma_{\varepsilon_2}^2)$	0.294	0.958
Precision total info to precision public info	$\sigma_{\varepsilon_1}^2 / \sum_{j=1}^3 \sigma_{\varepsilon_j}^2$	0.006	0.002
Variance private info to info acquisition cost	$\sigma_{\varepsilon_2}^2 / \tau$	0.590	0.168

Table 3: Additional model predictions and data

Variable	US		EA	
	data	mod	data	mod
Consumption to GDP ratio	0.85	0.78	0.77	0.76
Investment to GDP ratio	0.19	0.21	0.21	0.21
Average default rate	4.74	5.63	4.25	4.08
Def. rate loans to def. rate bonds ratio	0.80	1.12	0.73	0.82
Share abstain overall	n.a.	0.22	0.37	0.40
Entrepr. capital to aggr. capital ratio	0.46	0.25	n.a.	0.24

Table 4: Additional model predictions

Variable	Model	
	US	EA
Share abstain	0.028	0.000
Share bank	0.503	0.910
Share CMF	0.469	0.090
Drop-out if banking	0.376	0.444
Aggr. markup	1.041	1.021
Agency costs to GDP ratio	0.004	0.024

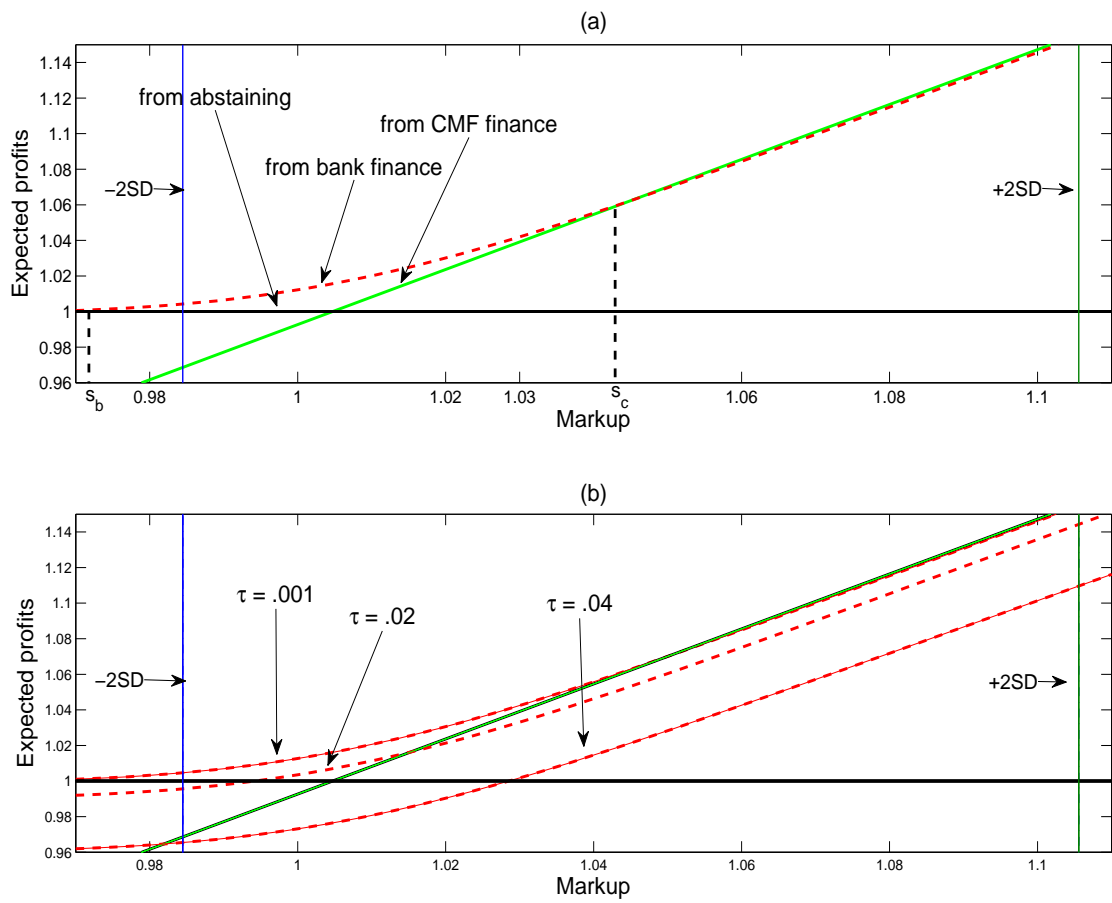


Figure1. Expected profits and financing choices

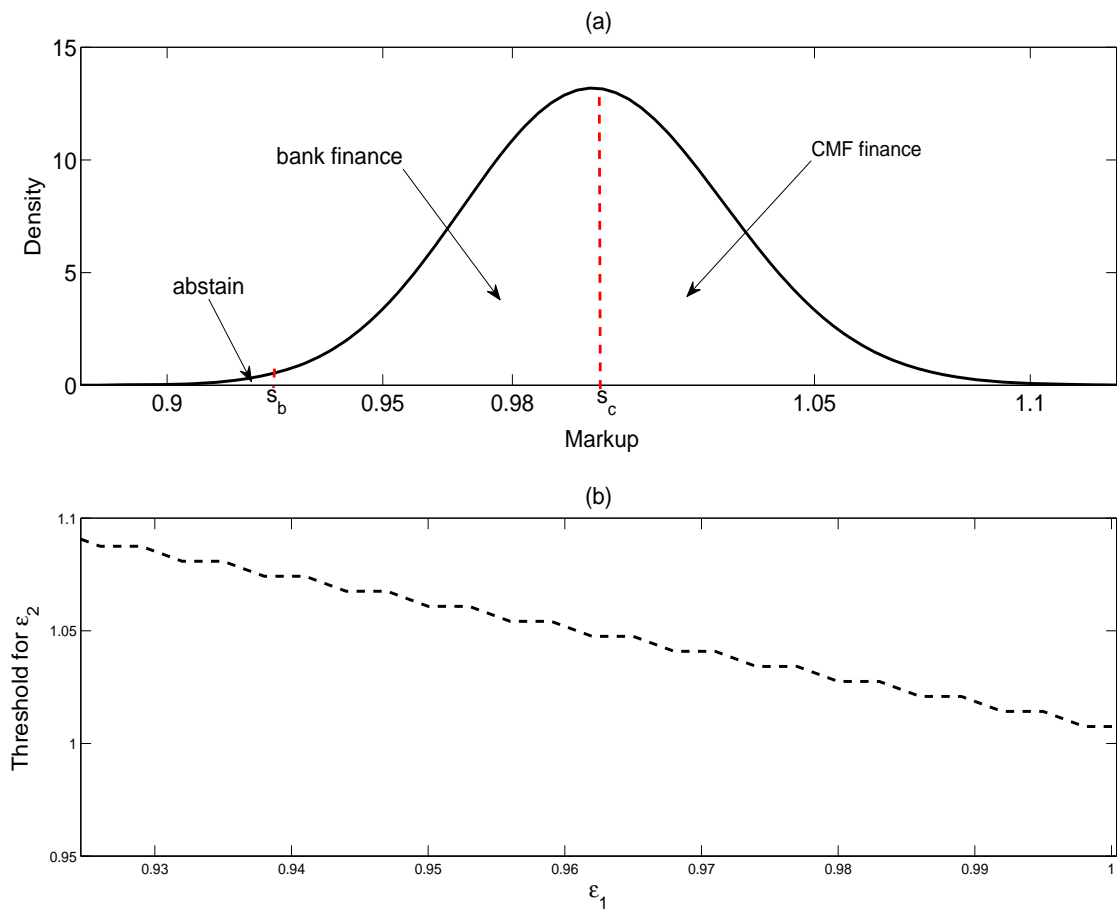


Figure 2. Distribution of financing choices and threshold for continuing with bank-financing.

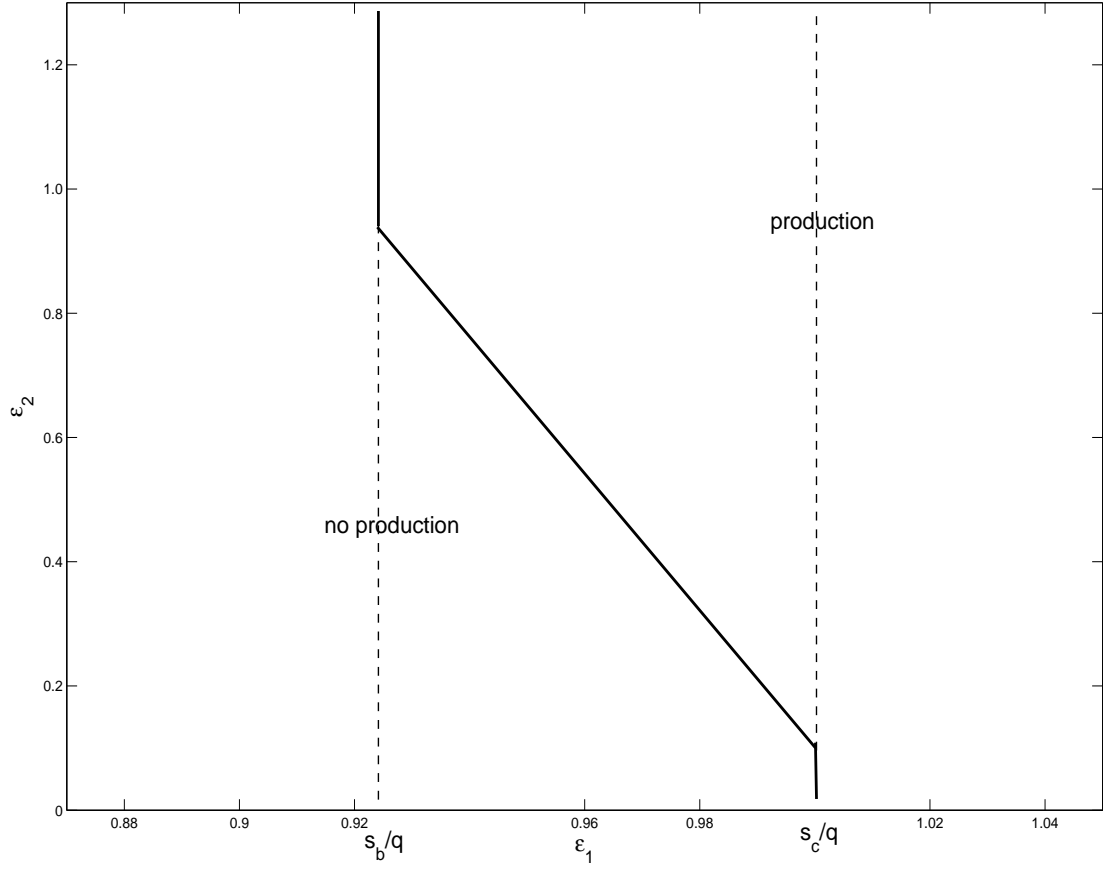


Figure 3. Financing choices as a function of observable shocks (ε_1 and ε_2).

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Bank Finance versus Bond Finance.

Appendix

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1 Proofs

1.1 Proposition 1

Conditions (7) and (15) imply that the expected profits of entrepreneurs willing to produce are not lower than the utility from disposing of the net worth initially invested. Notice that the problem is linear in \hat{n}_{it} . Thus, the solution is such that the entrepreneur either invest nothing and does not produce, $\hat{n}_{it} = 0$, or invest everything and produce, $\hat{n}_{it} = \tilde{n}_{it}$. Entrepreneurs that produce only raise costly external finance to cover what is needed in excess of the internal funds, $x_{it} - \tilde{n}_{it} = (\xi - 1)\tilde{n}_{it}$. To realize that equation (16) delivers a unique interior solution to the CSV problem, notice that $f(0) = 1$, $g(0) = 0$, $f'(\bar{\omega}_{it}^j) = \Phi_\omega(\bar{\omega}_{it}^j) - 1 < 0$, and $g'(\bar{\omega}_{it}^j) > 0$. This latter property can be shown by contradiction. Suppose $g'(\bar{\omega}_{it}^j) < 0$. Then, it would be possible to increase expected profits of the firm, $s_{it}f(\bar{\omega}_{it}^j)\xi\tilde{n}_{it}$, by reducing $\bar{\omega}_{it}^j$ while increasing expected profits of the FI, $s_{it}g(\bar{\omega}_{it}^j)\xi\tilde{n}_{it}$. Hence, $\bar{\omega}_{it}^j$ could not be a solution to the contract. It follows that the unique interior solution to the problem is given by (16).

1.2 Proposition 2

An entrepreneur that, upon payment of the information acquisition fee τn_{it} , observes $\varepsilon_{1,it}$ and $\varepsilon_{2,it}$, proceeds with the bank loan if and only if his expected profits exceeds the opportunity

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costs of renting his capital to others, i.e. if $s_{it}f(\bar{\omega}^b(s_{it}))\xi \geq 1$, where $s_{it} = \varepsilon_{1,it}\varepsilon_{2,it}q_t$. Notice that expected profits from proceeding with the bank are zero for $s_{it} = 0$ and strictly increasing in s_{it} , since $f'(\bar{\omega}^b) < 0$ and $\frac{\partial \bar{\omega}^b}{\partial s_{it}} < 0$. Hence, a solution to condition (17) exists and is unique. Moreover, it is constant across firms and time.

1.3 Proposition 3

Notice that $F^b(0) = 1 - \tau > F^c(0)$. Under (A1), there is a unique cutoff point s_b , which satisfies the condition $F^b(s) = 1$. A sufficient condition for existence and uniqueness of s_c is provided by (A1) and (A2). Both thresholds are constant across firms and time.

2 Aggregation

Define $\psi_x(q_t) \equiv \psi_x^c(q_t) + \psi_x^b(q_t)$, where

$$\begin{aligned}\psi_x^b(q_t) &\equiv \int_{\frac{s_b}{q_t}}^{\frac{s_c}{q_t}} \int_{\frac{s_d}{\varepsilon_1 q_t}} (1 - \tau) \Phi_2(d\varepsilon_2) \Phi_1(d\varepsilon_1) \\ \psi_x^c(q_t) &\equiv \int_{\frac{s_c}{q_t}} \Phi_1(d\varepsilon_1),\end{aligned}$$

and

$$\begin{aligned}\psi_y(q_t) &\equiv \int_{\frac{s_b}{q_t}}^{\frac{s_c}{q_t}} \int_{\frac{s_d}{\varepsilon_1 q_t}} (1 - \tau) \varepsilon_1 \varepsilon_2 \Phi_2(d\varepsilon_2) \Phi_1(d\varepsilon_1) + \int_{\frac{s_c}{q_t}} \varepsilon_1 \Phi_1(d\varepsilon_1) \\ \psi_m(q_t) &\equiv (1 - \tau) \int_{\frac{s_b}{q_t}}^{\frac{s_c}{q_t}} \int_{\frac{s_d}{\varepsilon_1 q_t}} \varepsilon_1 \varepsilon_2 \int^{\bar{\omega}^b(\varepsilon_1 \varepsilon_2 q_t)} \varepsilon_3 \Phi_3(d\varepsilon_3) \Phi_2(d\varepsilon_2) \Phi_1(d\varepsilon_1) \\ &\quad + \int_{\frac{s_c}{q_t}} \varepsilon_1 \int^{\bar{\omega}^c(\varepsilon_1 q_t)} \varepsilon_2 * \varepsilon_3 \Phi_{2*3}(d(\varepsilon_2 * \varepsilon_3)) \Phi_1(d\varepsilon_1) \\ \psi_\tau(q) &\equiv \tau \int_{\frac{s_b}{q_t}}^{\frac{s_c}{q_t}} \Phi_1(d\varepsilon_1),\end{aligned}$$

where Φ_{2*3} denotes the distribution function for the product $\omega = \varepsilon_2 \varepsilon_3$.

Now let $\vartheta_b(\varepsilon_1, q_t; s_d)$ be the average profits per unit of net worth of the bank-financed entrepreneurs, given ε_1 , aggregate information q_t , and the threshold s_d :

$$\vartheta_b(\varepsilon_1, q_t; s_d) = (1 - \tau) \left[\int_{\frac{s_d}{\varepsilon_1 q_t}}^{\frac{s_c}{q_t}} \varepsilon_1 \varepsilon_2 q_t f(\bar{\omega}^b(\varepsilon_1 \varepsilon_2 q_t)) \xi \Phi_2(d\varepsilon_2) + \Phi_2\left(\frac{s_d}{\varepsilon_1 q_t}\right) \right].$$

Also, let $\vartheta_c(\varepsilon_1, q_t)$ be the average profits per unit of net worth of the CMF-financed entrepreneurs, given ε_1 and q_t ,

$$\vartheta_c(\varepsilon_1, q_t) = \varepsilon_1 q_t f(\bar{\omega}^c(\varepsilon_1 q_t)) \xi,$$

and let $\vartheta(q_t) n_t$ be the aggregate profits of the entrepreneurial sector, where

$$\vartheta(q_t) = \Phi_1\left(\frac{s_b}{q_t}\right) + \int_{\frac{s_b}{q_t}}^{\frac{s_c}{q_t}} \vartheta_b(\varepsilon_1, q_t) \Phi_1(d\varepsilon_1) + \int_{\frac{s_c}{q_t}} \vartheta_c(\varepsilon_1, q_t) \Phi_1(d\varepsilon_1).$$

The aggregate budget constraints for the entrepreneurs can then be written as equation (33).

3 Agency costs

We show that the resource loss due to the presence of agency costs in the economy, y_t^a , corresponds to the sum of the monitoring costs faced by banks and CMFs, and of the information acquisition costs incurred by banks. For simplicity, we focus on the steady state of the model and denote steady state variables by dropping the time subscript.

First, divide the resource constraint of the economy by z , and notice that $\frac{I}{z} = \delta \frac{K}{z}$, $\frac{y}{z} = \psi_y(q) q \xi (1 - \delta + r)$ and $\frac{e}{z} = \vartheta(q) (1 - \delta + r) - 1$. Combining the budget constraint of the household,

$$c = wh + (r - \delta) k$$

with conditions $K = k + z$, $x = wh + rK$, and $x = \psi_x(q) \xi (1 - \delta + r) z$, we obtain

$$\frac{c}{z} = \psi_x(q) \xi (1 - \delta + r) - \delta \frac{K}{z} - r + \delta.$$

From the resource constraint, we can write agency costs as

$$y^a = y - c - e - \delta K,$$

implying that

$$\frac{y^a}{z} = (1 - \delta + r) [\psi_y(q) q \xi + 1 - \vartheta(q) - \psi_x(q) \xi]$$

Recall that $f(\bar{\omega}^j) = 1 - g(\bar{\omega}^j) - \mu \int_0^{\bar{\omega}^j} \omega^j \Phi_\omega(d\omega)$. Use this condition together with equation (16), $\Phi_1\left(\frac{s_b}{q}\right) + \int_{\frac{s_b}{q}}^{\frac{s_c}{q}} \Phi_1(d\varepsilon_1) + \int_{\frac{s_c}{q}} \Phi_1(d\varepsilon_1) = 1$, and the definitions of $\psi_m(q_t)$ and $\psi_\tau(q)$ given in section 2 of this appendix. After rearranging terms, we obtain

$$\frac{y^a}{z} = (1 - \delta + r) [\psi_m(q) + \psi_\tau(q)]$$

implying that $y^a = y^m + y^\tau$.

4 The stochastic steady state

The unique steady state can be obtained as follows. First, we specify one of the endogenous variables, q , as exogenous and we treat γ as endogenous. For each value of q , we can then compute r, w, γ and c by solving the equations

$$\begin{aligned} 1 &= \beta (1 - \delta + r) \\ q &= \left(\frac{\alpha}{w}\right)^\alpha \left(\frac{1 - \alpha}{r}\right)^{1-\alpha} \\ 1 &= \beta\gamma \{(1 - \delta + r)F(\varepsilon_1 q)\} \\ \eta c &= w. \end{aligned}$$

To compute the overall expected profits $F(\varepsilon_1 q)$, given by the steady state version of equation (25), we use the following procedure. First, under our distributional assumptions about the productivity shocks $\varepsilon_1, \varepsilon_2$ and ε_3 , we can use some results from the optimal contract literature (see the appendix of Bernanke et al (1999)),

$$\begin{aligned} \varphi_\omega(\bar{\omega}^j) &= \varphi(x) \frac{1}{\bar{\omega}^j \sigma} \\ f(\bar{\omega}^j) &= \Phi(x - \sigma) + \bar{\omega}^j [1 - \Phi(x)] \\ g(\bar{\omega}^j) &= (1 - \mu) \Phi(x - \sigma) + \bar{\omega}^j [1 - \Phi(x)], \end{aligned}$$

where φ and Φ denote the standard normal, $x \equiv \frac{\log \bar{\omega}^j + 0.5\sigma^2}{\sigma}$ and $j = b, c$. Second, we solve numerically the condition $sg(\bar{\omega}^j(s)) = \frac{\xi - 1}{\xi}$ to obtain the function $\bar{\omega}^j(s)$. The function $\bar{\omega}^b(s)$ for bank-financed firms is derived by defining $s = \varepsilon_1 \varepsilon_2 q$ and by using the variance $\sigma_{\varepsilon_3}^2$ of the log-normal distribution. The function $\bar{\omega}^c(s)$ for CMF-financed firms is derived by defining $s = \varepsilon_1 q$ and by using the variance $\sigma_{\varepsilon_2}^2 + \sigma_{\varepsilon_3}^2$. The cutoff value for proceeding with the bank loan is found by solving numerically the condition $s_d f(\bar{\omega}^b(s_d)) \xi = 1$. Using s_d , it is then possible to compute the expected profits for the bank-financed entrepreneur, $F^b(s)$, where $s = \varepsilon_1 q$. The expected profits for the CMF-financed entrepreneur can be computed as $F^c(s) = s f(\bar{\omega}^c(s)) \xi$. With this, it is possible to calculate the overall return $F(s)$ to entrepreneurial investment, the thresholds s_b and s_c , and the ratios $\frac{x}{z}, \frac{K}{x}$ and $\frac{l}{x}$, as given by

$$\begin{aligned} \frac{x}{z} &= \psi_x(q; s_b, s_c, s_d) \xi (1 - \delta + r) \\ \frac{K}{x} &= \frac{1 - \alpha}{r} \end{aligned}$$

$$\frac{l}{x} = \frac{\alpha}{w},$$

where the function $\psi_x(\cdot)$ is the steady state version of the function defined in section 2 of this appendix. Now write the budget constraint of the household as

$$\frac{c}{z} = w\frac{l}{z} + (r - \delta)\frac{k}{z},$$

where $\frac{l}{z} = \frac{l}{x}\frac{x}{z}$ and $\frac{k}{z} = \frac{K}{x}\frac{x}{z} - 1$. Then, compute z as $z = \frac{c}{\frac{c}{z}}$ and use it to compute the aggregate variables n, x, K, l, k and c . Finally, use the steady state version of equations (29) and (33) to compute y and e , and of the resource constraint (36) to compute y^a .

5 Evidence on the financial structure

We document differences in corporate finance among the US and the EA. The series used for the EA refer to a changing composition, i.e. they are based on the euro area composition at the time to which the statistics relate. Our focus is on the EMU period but we only consider data up to 2007 in order to exclude the major effects of the financial turmoil, which resulted in a sudden drying up of the market for corporate bonds in both the US and the EA.

Ratio of bank finance to bond finance. For the US, the average value of loans to securities over the period 1999-2007 is 0.66. For the EA, the ratio is 5.48, approximately eight times higher. Data are from Flow of Funds Accounts, Table B.102 on the balance sheet of nonfarm nonfinancial corporations. Securities are the sum of commercial paper, municipal securities and corporate bonds. Loans are the sum of bank loans, mortgages and other loans and advances. For the EA, data are from the Euro Area Flow of Funds. Loans are those extended by monetary financial institutions to non-financial corporations. Securities are defined as securities other than shares, excluding financial derivatives, issued by non-financial corporations.

Debt to equity ratio. The debt to equity ratio for the US non-farm, non-financial corporate business sector is 0.43 over the period 1999-2007. For the EA, the ratio is 0.64 over the same period. For the US, data are from the Flow of Funds Accounts. Debt is defined as credit market instruments (sum of commercial paper, municipal securities, corporate bonds, bank loans, other loans and advances, mortgages). Equity is defined as market value of equities outstanding (including corporate farm equities). For the EA, data are from the Quarterly Euro Area Accounts. Debt includes loans, debt securities issued and pension fund reserves of non-financial corporations. Equity includes shares and other equity.

Risk premium on bank loans. For the US, the mean spread between the loan rate and the Federal Fund rate over the period Jan1999-Dec2007 is 170 bps. For the EA, over the same period, the spread between the average loan rate and the EONIA is 119 bps. To obtain a comparable measure of the cost of loans for the US and EA, and because the time period in our model is a year, we consider loans to non-financial corporations (new businesses) with a maturity interval of below 1 year and with floating rates. In 2007, these loans accounted for approximately 86% of total loans to new businesses in the EA and to 92% in the US. For the US, we use data from the Survey of Terms of Business Lending. For the EA, we use ECB data from MFI Interest Rate Statistics. Since the series for the EA distinguish amounts of up to and including EUR 1 million amount, and amounts above EUR 1 million, we compute average loan rates using relative amounts to build weights. The series on amounts is available only since Jan 2003. We use the actual weight when available and the average weight over the whole period otherwise.

Risk premium on corporate bonds. Comparable series for the US and the EA are only available for the mean difference between 7 to 10 years corporate bond yields and government bond yields with a corresponding maturity (ECB data on Financial Market Indicators). Over the period Jan1999-Dec2007, the mean difference is 143 bps for the US. Due to the changing composition of the euro area and the thin market for corporate bonds in the early sample, reliable data for the EA start in 2002. Over the period Jan 2002-Dec 2007, the mean difference is approximately the same in the EA and the US (128 and 126 bps respectively). Therefore, in table 1 we attribute to the euro area the same mean difference observed in the US. Existing studies confirm that no significant differences exist among bond spreads in the US and the EA. Mahajan and Fraser (1986) find no differences in yields between dollar denominated Eurobonds and US bonds with similar characteristics over the period 1975-1983. Using more recent data, Carey and Nini (2007) show that mean differences for A- and BBB-rated firms among US and EA remain small even after accounting for duration and currency effects. Gilchrist, Yankov and Zakrajšek (2009) report mean credit spreads for corporate bonds of short maturity (remaining term-to-maturity of less than 3 years) after grouping them in five quantiles according to their expected default frequencies. Although the mean spreads vary substantially with default probabilities, the levels (0.79, 1.03, 1.21, 1.84, and 5.28 percent, respectively) are distributed around our chosen value.

Default rate on corporate bonds. Using data from Moody's, we compute the average 12-months default rate on speculative-grade bonds for non-financial corporations. For the period Jan1999-Dec2007, the average figure for the US is 5.37%. For the EA, the average figure over the same period is 4.96%.

Expected rate of return on capital. We compute the net rate of return of capital as the gross operating surplus net of depreciation capital as a percentage of total net capital. This measure of the value of capital service flows for corporations is a broad indicator of profit developments. In our model, it captures the average expected net return from accumulating one unit of entrepreneurial capital. Using data from the EU Commission's Ameco database, we compute its average value at 10.9% for the US and 9.3% for the EA, over the period 1997-2005.

The model offers some additional model predictions (not used as targets in the estimation procedure) that can be compared with the data. We document here the evidence presented in tables 3 and 4.

Ratio of aggregate consumption to GDP. The ratio is 0.85 for the US and 0.77 for the EA. Data are for the period 1999-2007 from ESA95 national accounts.

Ratio of aggregate investment to GDP. The ratio is 0.19 for the US and 0.21 for the EA. Data are for the period 1999-2007 from ESA95 national accounts.

Average default rate. The annual rate is 4.74 percent for the US and 4.25 percent for the EA. We measure the average default rate with Moody's 12-months default rate by speculative-grade rated non-financial corporations, over the period January 1999 to December 2007.

Ratio of default on loans to default on bonds. It is 0.80 for the US and 0.73 for the EA. The numbers are taken from Emery and Cantor (2005). Based on an analysis of 582 non-financial corporates between Jan1995 and Jun2003, they find that in the US the default rate on loans is lower than the default rate on bonds by approximately 20%. Similar results are found for European firms. Using data on 29 European non-financial corporate issuers, the approximate reduction in the loan default rate relative to the bond default rate is 27%.

Share abstain overall. We use data from the ENSR Enterprise Survey 2002 to shed light on the share of firms that do not raise external finance. The ENSR survey collects data on small and medium size European enterprises (representing 99.8% of total enterprises in the EA). It is documented that, during the three years previous to the survey, 37 percent of the firms considered did not request a bank loan. Given the size of these firms, it is unlikely

that they would finance themselves on the market if they do not do so through banks. We therefore take this number as providing indirect evidence on the share of firms that does not raise external finance.

Firms' capital as a share of aggregate capital. Based on US data from the 2004 Survey of Consumer Finances, Sandri (2009) documents that entrepreneurs own around 46% of total wealth.

6 Financial variables

We provide analytical expressions for the financial variables used in the numerical application.

The ratio of bank finance to bond finance, Υ_t is defined as the ratio of the funds raised by bank-financed firms to the funds raised by CMF-financed firms. The amount of external finance raised by a producing firm i is $x_{it} - \widehat{n}_{it} = (\xi - 1) \widehat{n}_{it}$. It follows that

$$\Upsilon_t = \frac{\psi_x^b(q_t)}{\psi_x^c(q_t)}.$$

The average risk premia for bank-financed firms and CMF-financed firms are denoted respectively as rp_t^b and rp_t^c . Given the solution to the contract, $\bar{\omega}^j(s_{it})$, the risk premium for a firm i that chooses to raise external finance from intermediary j , rp_{it}^j , is implicitly given by the condition

$$(1 + rp_{it}^j)(x_{it} - \widehat{n}_{it}) = s_{it} \bar{\omega}_{it}^j x_{it}, \quad j = b, c.$$

The average risk premia for bank-financed firms and for CMF-financed firms are then given by

$$rp_t^b \equiv \frac{\int_{\frac{s_b}{qt}}^{\frac{s_c}{qt}} \int_{\frac{s_d}{\varepsilon_1 qt}} \left[\left(\frac{\xi}{\xi-1} \right) q_t \varepsilon_1 \varepsilon_2 \bar{\omega}^b(\varepsilon_1 \varepsilon_2 q_t) - 1 \right] \Phi_2(d\varepsilon_2) \Phi_1(d\varepsilon_1)}{\int_{\frac{s_b}{qt}}^{\frac{s_c}{qt}} \int_{\frac{s_d}{\varepsilon_1 qt}} \Phi_2(d\varepsilon_2) \Phi_1(d\varepsilon_1)}$$

$$rp_t^c \equiv \frac{\int_{\frac{s_c}{qt}} \left[\left(\frac{\xi}{\xi-1} \right) q_t \varepsilon_1 \bar{\omega}^c(\varepsilon_1 q_t) - 1 \right] \Phi_1(d\varepsilon_1)}{\int_{\frac{s_c}{qt}} \Phi_1(d\varepsilon_1)}.$$

The aggregate debt to equity ratio, d_t , is defined as the ratio of all debt instruments used by producing firms to the aggregate net worth of existing firms,

$$d_t = (\xi - 1) \left[\psi_x^b(q_t) + \psi_x^c(q_t) \right].$$

The default rate on bank loans, Δ_t^b , is defined as the share of firms which approaches banks but cannot repay the debt,

$$\Delta_t^b = \frac{\int_{\frac{s_b}{qt}}^{\frac{s_c}{qt}} \int_{\frac{s_d}{\varepsilon_1 qt}}^{\frac{s_d}{\varepsilon_1 qt}} \Phi_3(\bar{\omega}^b(\varepsilon_1 \varepsilon_2 qt)) \Phi_2(d\varepsilon_2) \Phi_1(d\varepsilon_1)}{\int_{\frac{s_b}{qt}}^{\frac{s_c}{qt}} \Phi_2(d\varepsilon_2) \Phi_1(d\varepsilon_1)}.$$

Similarly, the default rate on bonds, Δ_t^c , is given by the share of firms which borrow from CMFs but cannot repay the debt,

$$\Delta_t^c = \frac{\int_{\frac{s_c}{qt}}^{\frac{s_c}{qt}} \Phi_{2*3}(\bar{\omega}^c(\varepsilon_1 qt)) \Phi_1(d\varepsilon_1)}{\int_{\frac{s_c}{qt}}^{\frac{s_c}{qt}} \Phi_1(d\varepsilon_1)}.$$

Average default amounts to the share of firms which sign a contract with either a bank or a CMF but cannot repay the debt.

The gross expected return on equity is measured by $(1 - \delta + r)F(\varepsilon_1 q) = \frac{1}{\beta\gamma}$. Our target for a net expected return on equity, r_t^e , is then given by

$$r_t^e = \frac{1}{\beta\gamma} - 1.$$

7 Robustness analysis: an alternative choice for τ and μ .

The results reported in the paper (table 2, column labelled “mod”) show that the model requires different information acquisition costs, in order to replicate US and EA data. The parameter τ is .001 for the US and .028 for the EA. In the paper, we argue that such difference may be needed for the model to capture the data, because monitoring costs are assumed to be identical despite differences in bankruptcy laws and procedures.

In order to check the robustness of our results, we have investigated alternative parameters. More specifically, we have maintained the monitoring costs μ for the US at .15 (in line with available empirical evidence), while allowing the calibration procedure for the EA to select the monitoring parameter, using the parameters of the US model as initial values, and restricting τ to take progressively closer values to the one obtained for the US.

The columns labelled “data” and “model EA” in tables A1 to A4 coincide with the results presented in the paper, whereas the columns labelled “model EA1” provide the alternative calibration. Indeed, the best fit is found for a lower level of monitoring costs, $\mu = .124$, and for an information acquisition cost parameter that is much closer to the one selected for the US,

i.e. $\tau = .005$. Nonetheless, the fit of “model EA1” with the data is worse than the one offered by the benchmark EA model: numerically, it appeared to be very difficult to get closer to the data, when restricting τ to values similar to those selected by the numerical procedure for the US. Note, though, that the model predictions and the focal statistics are qualitatively similar: we interpret this as a sign of robustness of our results. Therefore, our interpretation of the corporate finance differences remains valid under this alternative parameterization.

As a further robustness check, we also attempted to solve for the model by equating the value of τ in the EA to the value of 0.001 in the US, and solve for μ . We then had considerably greater numerical difficulty to match the observed facts than already emanate from the column labeled “model EA1”. We suspect that the rather intricate nonlinearities in these six equations may prevent the system to have a solution at all: there obviously is no reason to expect a nonlinear system of six equations in six unknowns to have a solution. The same problem may be the reason underlying the apparent worsening fit in the column “model EA1”. While this may be an interesting issue that could be explored further, it is an issue that leads us rather far astray from the main focus of the paper.

Table A1: Financial facts

Variable	data US	mod US	data EA	mod EA	mod EA1
Bank to bond finance ratio	0.66	0.67	5.48	5.48	5.48
Debt to equity ratio	0.43	0.43	0.64	0.64	0.63
Risk premium on loans (bps)	170	169	119	119	126
Risk premium on bonds (bps)	143	143	143	147	132
Default rate on bonds (pp)	5.37	5.36	4.96	4.79	5.01
Return to entr capital (pp)	10.90	10.93	9.30	9.29	9.28

Table A2: Financial predictions

Parameters	Symbols	Model		
		US	EA	EA1
Monitoring costs	μ	0.150	0.150	0.124
Information acquisition	τ	0.001	0.028	0.005
Coeff. discount rate entr.	γ	0.939	0.953	0.953
Project size to net worth	ξ	1.551	2.102	1.784
Standard dev. ε_1	σ_{ε_1}	0.037	0.014	0.003
Standard dev. ε_2	σ_{ε_2}	0.024	0.069	0.031
Standard dev. ε_3	σ_{ε_3}	0.488	0.335	0.405
Overall variance unobserved shocks	$\sum_{j=2}^3 \sigma_{\varepsilon_j}^2$	0.238	0.117	0.165
Precision avail info to precision private info	$\sigma_{\varepsilon_2}^2 / (\sigma_{\varepsilon_1}^2 + \sigma_{\varepsilon_2}^2)$	0.294	0.958	0.991
Precision total info to precision public info	$\sigma_{\varepsilon_1}^2 / \sum_{j=1}^3 \sigma_{\varepsilon_j}^2$	0.006	0.002	0.000
Variance private info to info acquisition cost	$\sigma_{\varepsilon_2}^2 / \tau$	0.590	0.168	0.190

Table A3: Additional model predictions and data

Variable	data US	mod US	data EA	mod EA	mod EA1
Consumption to GDP ratio	0.85	0.78	0.77	0.76	0.78
Investment to GDP ratio	0.19	0.21	0.21	0.21	0.22
Average default rate	4.74	5.63	4.25	4.08	4.87
Def. rate loans to def. rate bonds ratio	0.80	1.12	0.73	0.82	0.97
Share abstain overall	n.a.	0.22	0.37	0.40	0.19
Entrepr. capital to aggr. capital ratio	0.46	0.25	n.a.	0.24	0.21

Table A4: Additional model predictions

Variable	Model		
	US	EA	EA1
Share abstain	0.028	0.000	0.000
Share bank	0.503	0.910	0.875
Share CMF	0.469	0.090	0.125
Drop-out if banking	0.376	0.444	0.216
Aggr. markup	1.041	1.021	1.031
Agency costs to GDP ratio	0.004	0.024	0.006